Chapter 6
HYDRODYNAMICS OF TIDAL INLETS

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Chapter II-6
Hydrodynamics of Tidal Inlets

II-6-1. Introduction to Inlet Hydrodynamic Processes

a. Inlet functions.

(1) Inlets provide both man and nature with a means of access between the ocean and a bay. Commercial and recreational vessels need a navigable channel for safe transit to interior harbors. The flow of currents into and out of a bay through an inlet provides natural flushing to maintain good water quality and reasonable salinity levels. The migration of fish, fish larvae, and other sea life through the inlet conduit is also an important function of an inlet. Successful engineering of inlets requires knowledge of water and sediment movement in and adjacent to the inlet.

(2) Hydrodynamic conditions at tidal inlets can vary from a relatively simple ebb-and-flood tidal system to a very complex one in which tide, wind stress, freshwater influx, and wind waves (4- to 25-s periods) have significant forcing effects on the system. Figure II-6-1 shows a structured and an unstructured inlet with waves breaking on a shallow ebb shoal nearly surrounding the inlet itself. Flow enters the bay (or lagoon) through a constricted entrance, which is a relatively deep notch (usually 4 to 20 m at the deepest point). Entrance occurs after flow has traversed over a shallow shoal region where the flow pattern may be very complex due to the combined interaction of the tidal-generated current, currents due to waves breaking on the shallow shoal areas, wind-stress currents, and currents approaching the inlet due to wave breaking on adjacent beaches. The inlet acts to interrupt longshore current, which either reinforces or interferes with tidal currents, dependent on the time in the tidal cycle. The longshore current also is variable, dependent on wave conditions. Particularly during stormy conditions with strong winds, flow patterns may be highly complex. Also, the complicated two-dimensional flow pattern is further confounded because currents transverse to the coast tend to influence the propagation of waves, in some cases blocking them and causing them to break. The inlet has a complex shoal pattern that would cause odd refraction patterns and breaking regions, even if tidal flows were weak . Final complications are structures such as jetties, which cause wave diffraction patterns and reflections.

(3) In inlets with large open bays and small tidal amplitudes, flows can be dominated by wind stress (Smith 1977). In such cases, ebb conditions can last for days when winds pile up water near the bay side of the inlet, or long floods can occur when winds force bay water away from the inlet. Most inlet bays, however, are small and some are highly vegetated, so wind stress is not a dominant feature, except under storm conditions (this chapter will emphasize tidal components of the system; Part II-5 provides approaches for considering storm surges and seiche). Though not forced by tides, inlets on large lakes may have significant currents due to seiching (Seelig and Sorensen 1977), and may be studied by the methods in this chapter. Although many bays do not receive much fresh water relative to the volume of tidal flow, substantial freshwater input due to river flow can sometimes create vertically stratified flows through a tidal inlet. Typically, however, well-mixed conditions exist for most inlets. Neither the effects of wind on the bay nor stratified flows will be examined in this chapter; however, the gross effect of freshwater flow on inlet hydraulics will be discussed.

This chapter also provides simplified methods for estimating tidal hydraulics. In general, the inlet problem requires complex, complicated analyses, and reference will be made to such techniques.